Sudbury Neutrino Observatory Non-Physics Background Revomal

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During the course of commissioning the Sudbury Neutrino Observatory (SNO) events which are artifacts of the hardware and electronics were observed. A study of these events was undertaken with several goals in mind:

- Removal of these nonphysical events from the data.
- Investigation of any temporal or spatial preferences and trends.
- Investigation of the possibility that these events are precursors to problems in the detector.

The two main nonphysical event types are known as "Shark Fin" and "Flasher". A Shark Fin event is a pickup in the electronics that causes a cluster of PMT hits in a small region of the detector. The name itself comes from the PMT pulse shape, which happens to be reminiscent of a shark fin. A Flasher event is characterized as having a cluster of PMT hits in a small region of the detector accompanied by a scattered arrangement of hits on the opposite side with times consistent with light travelling from the cluster.

When the trends in the flasher rate were investigated it was found that there was a rate increase during periods of calibration, construction and maintenance activities. Regarding the increase in the flasher rate during calibration runs, we suspect that the calibration events have characteristics similar to those used to identify flashers, thus they are classified as flashers by our filters. Taking this into consideration, we are left with the observation that flasher rates tend to increase when maintenance work is being done on the detector. Higher shark fin rates, however, did not increase with calibration runs or during periods of detector maintainence.

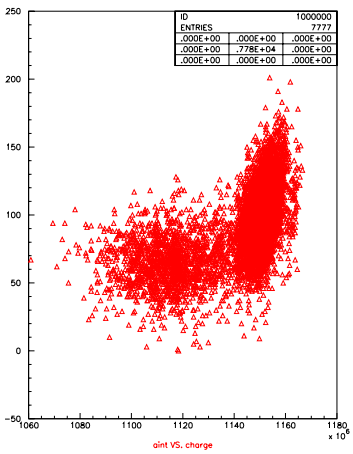

Figure 1: Plot of integrated analog sum vs total PMT charge. The structure on the left is due to the non-physical background.

One method found for removing shark fins and flashers is with a graphical cut that can be placed on an integrated charge vs. total charge graph. The integrated charge is the integral of the analog sum of all PMT signals. The total charge is the sum of the charges seen in all channels of the electronics. The relationship between the integrated charge and the total charge is expected to be linear. However when we looked at these charges nonphysical events exhibited an atypical behavior as shown in Figure 1. By placing a graphical cut on the Integrated vs. Total charge plot we were able remove nonphysical events that passed the previously existing filters.

Shark fins have a specific behavior of triggering a small number of PMT hits, and have a saturated integrated charge. We found that not all events with this behavior were removed by other filters. This was determined to be an effective addition to the other cuts that are placed on the data.